ALS beamline 12.2.2

Martin Kunz

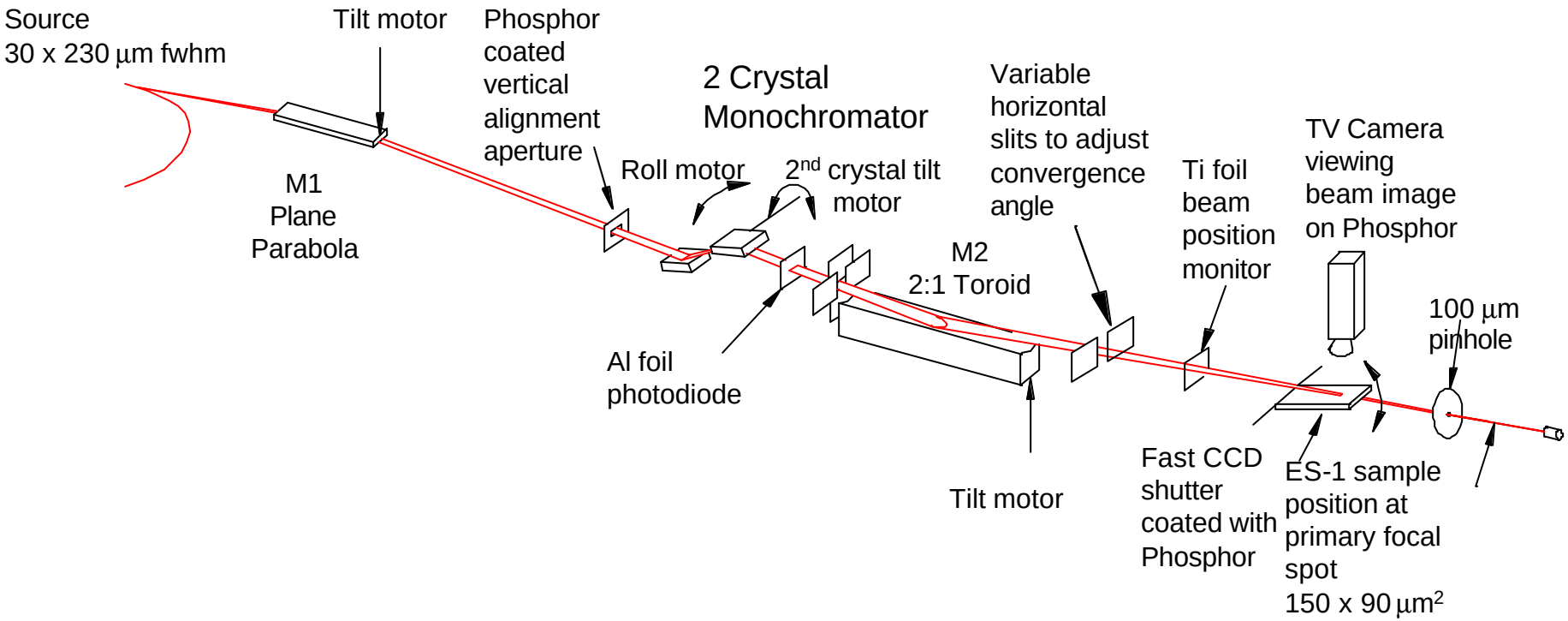
2006 Calipso Review

Outline:

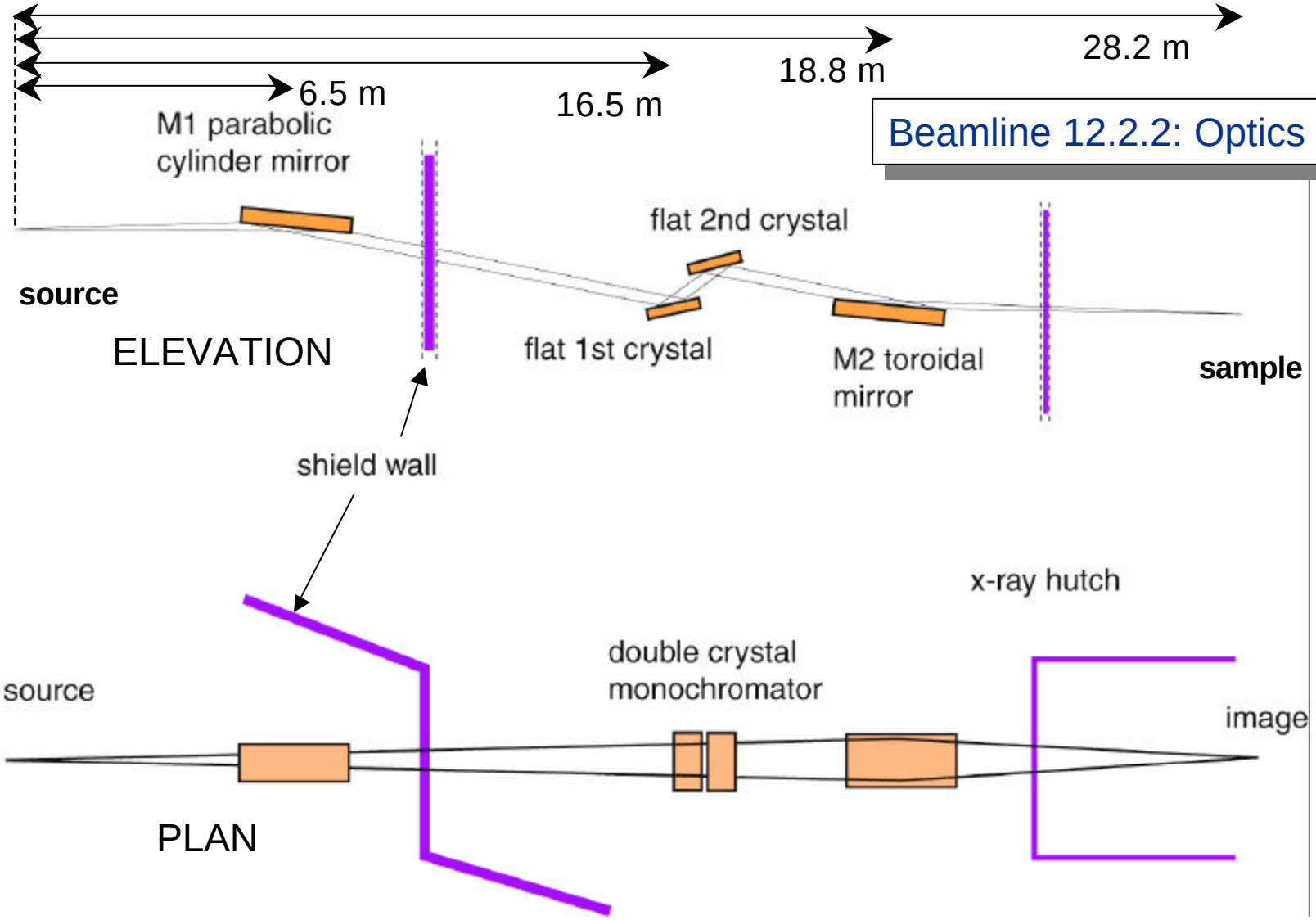
- Beamline layout.
- Experimental station.
- Diffraction experiments: Resistive heating.
- X-ray absorption imaging (Walker/Walter).
- Viscosity measurements (Grocholski/Jeanloz).
- Radial diffraction (Merkel/Lowell/Wenk).
- Development: EXAFS.
- Development: In situ laser heated radial diffraction.
- Development: Upgrade end-station 1.

2006 Calipso Review: Beamline Layout

Beamline 12.2.2: Layout

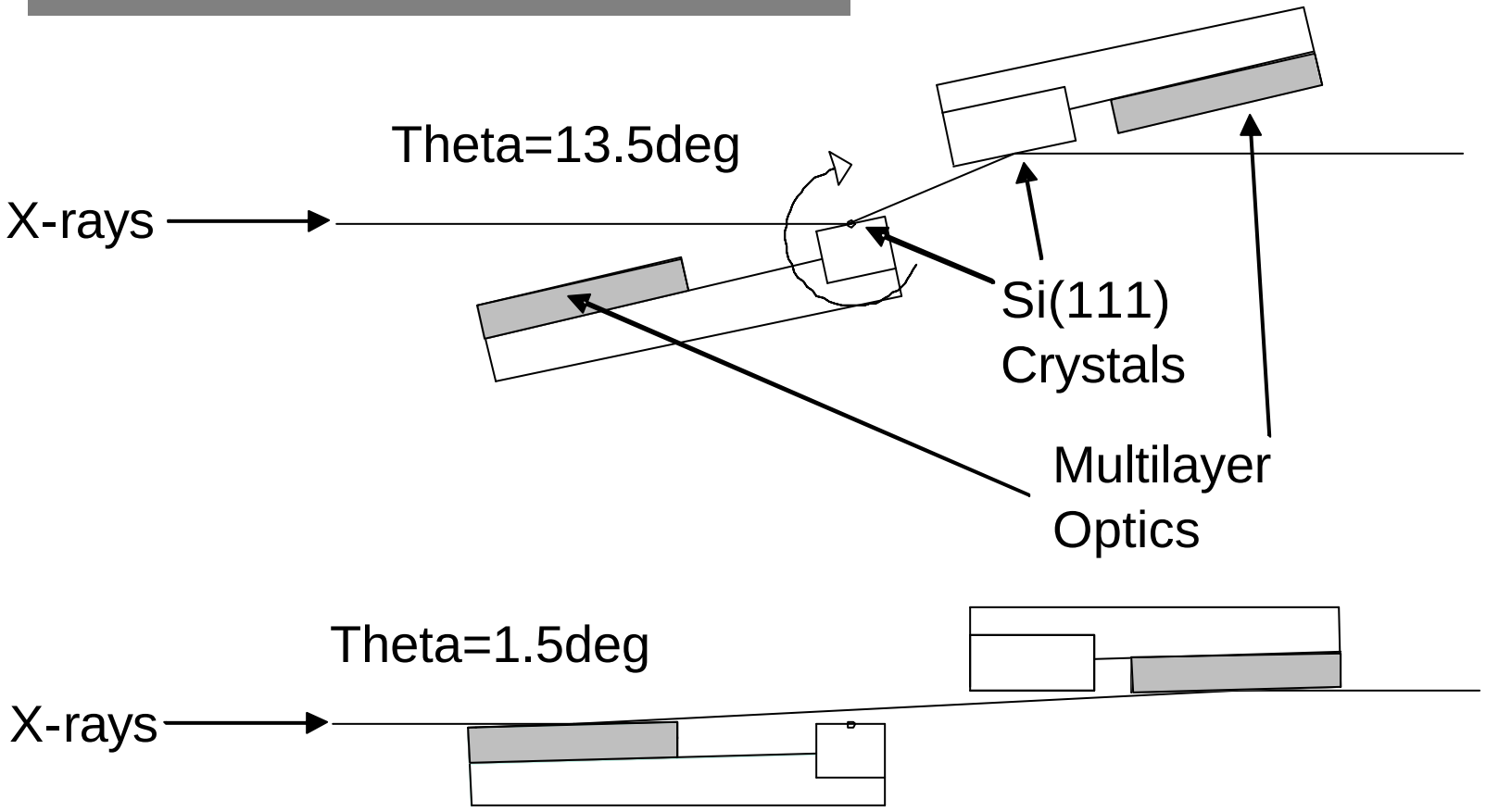


2006 Calipso Review: Beamline Layout



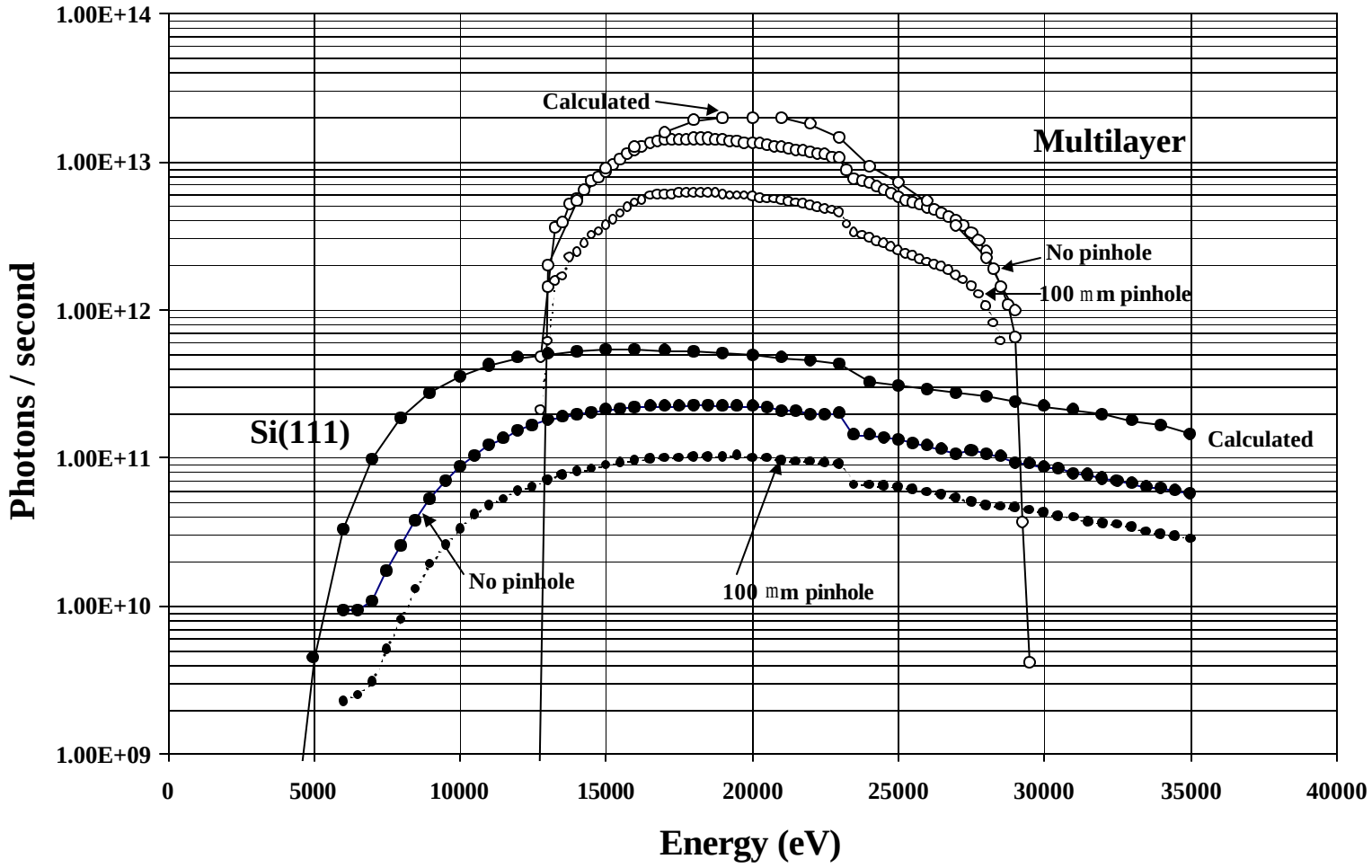
2006 Calipso Review: Beamline Layout

Beamline 12.2.2: Monochromator



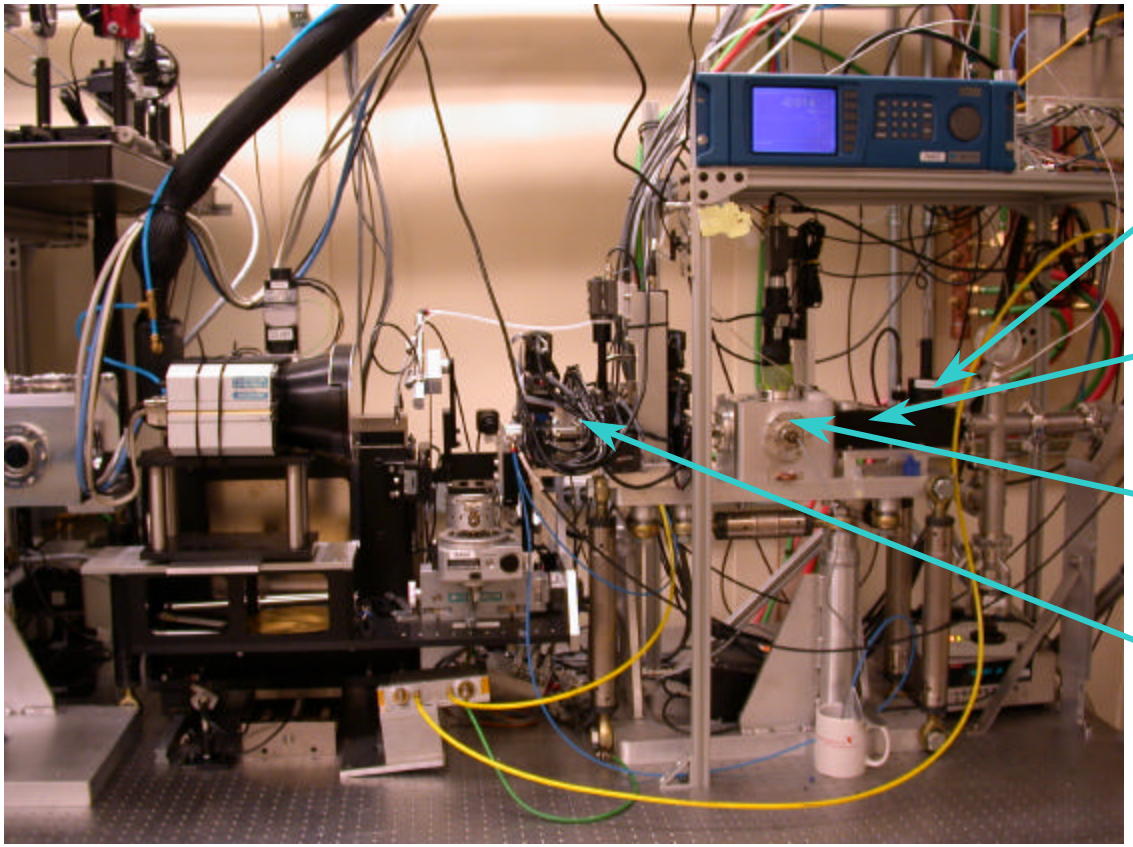
2006 Calipso Review: Beamline Layout

Beamline 12.2.2: Flux



2006 Calipso Review: Experimental Stations.

End station 1:



- Beam position monitor 1
- Filters
- Shutter and 2nd bpm
- 4 pairs of Slits (also virtual source for K-B-mirrors)

2006 Calipso Review: Experimental Stations.

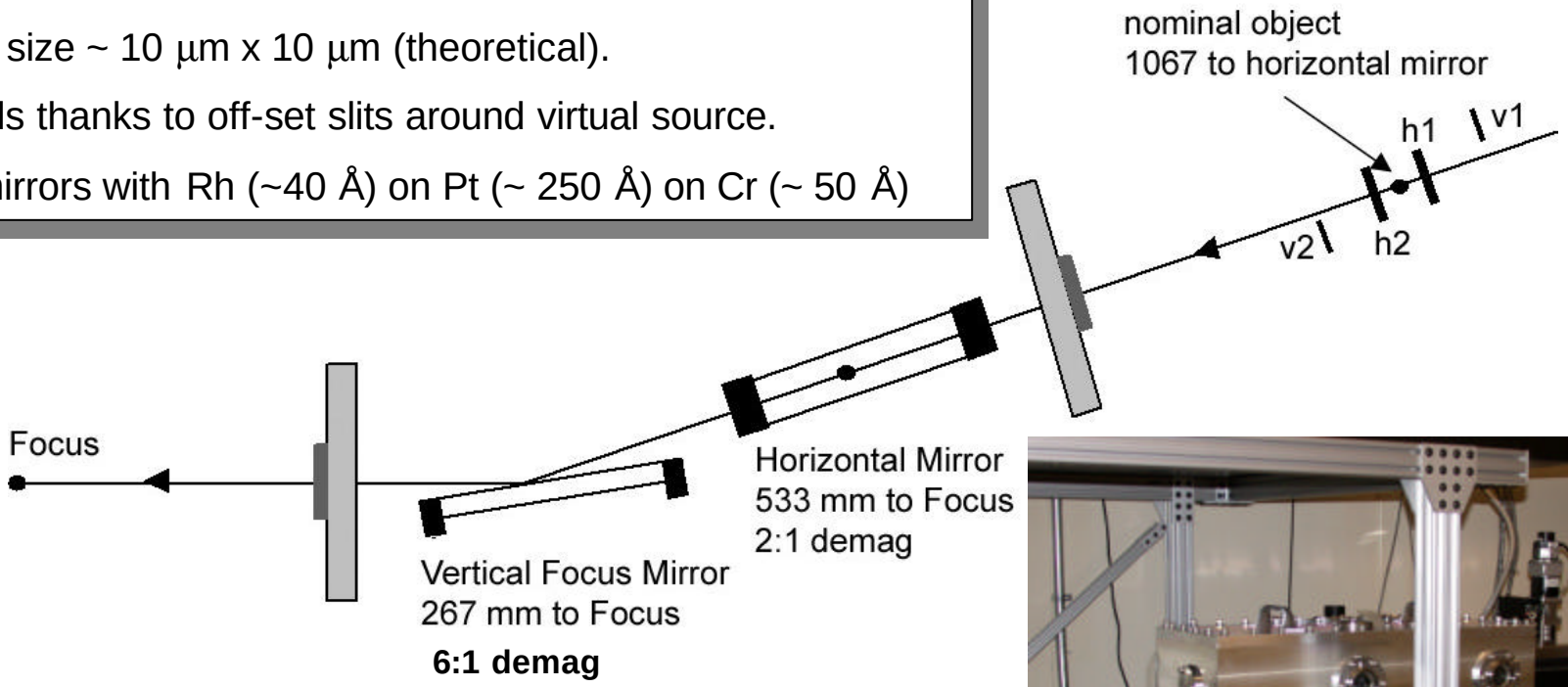
K-B-mirrors:

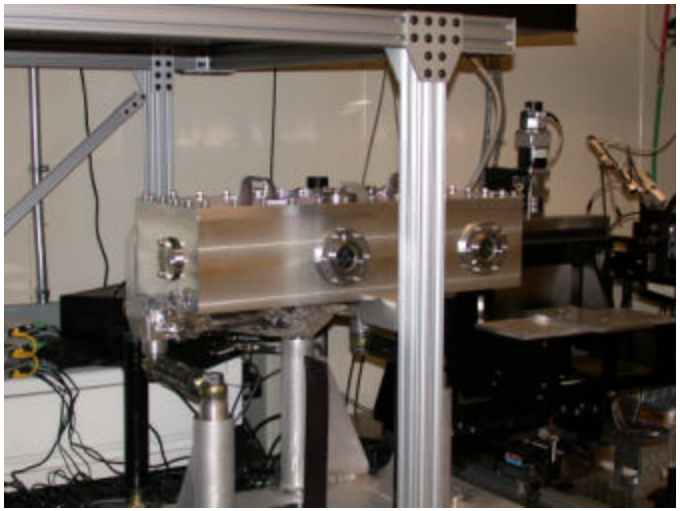
Virtual source is re-imaged on sample position of ES-2.

Beam size ~ 10 μm x 10 μm (theoretical).

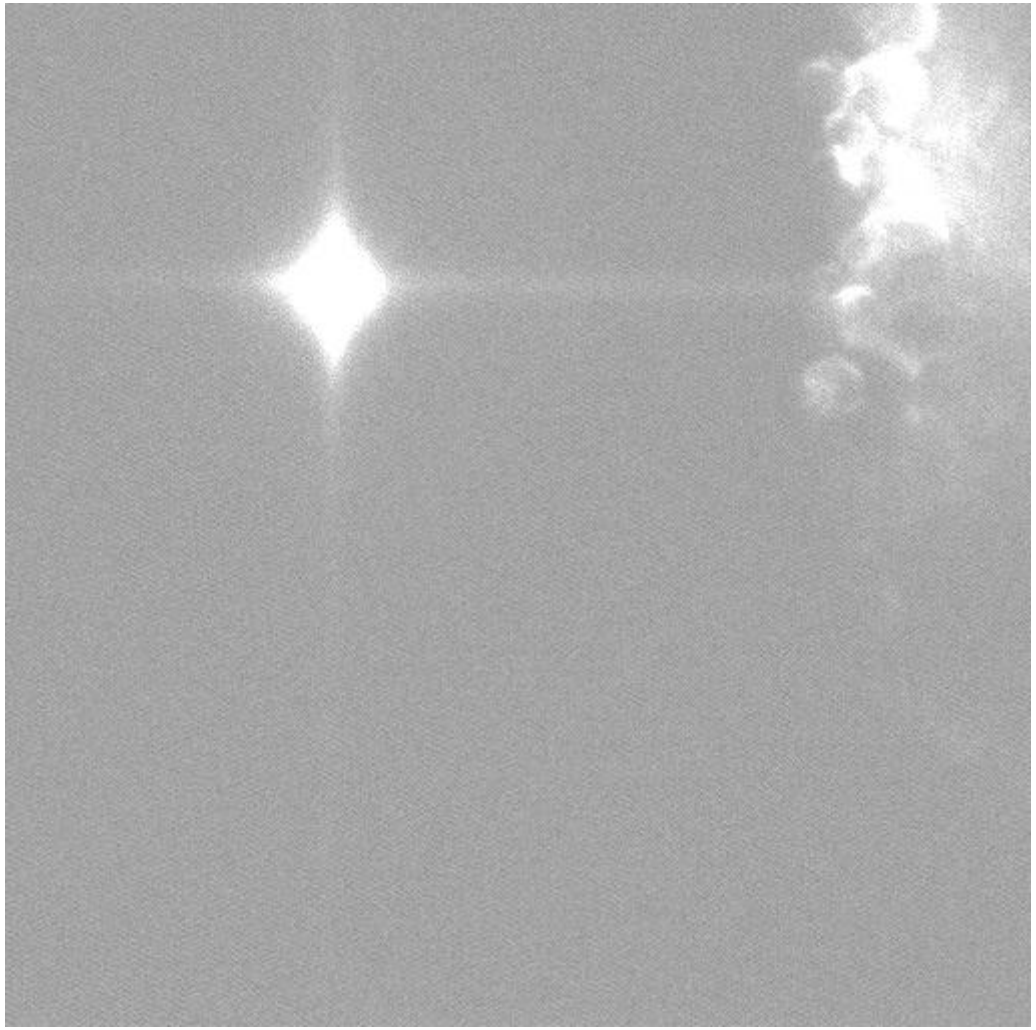
No tails thanks to off-set slits around virtual source.

2 Si mirrors with Rh (~40 Å) on Pt (~ 250 Å) on Cr (~ 50 Å)





2006 Calipso Review: Experimental Stations.



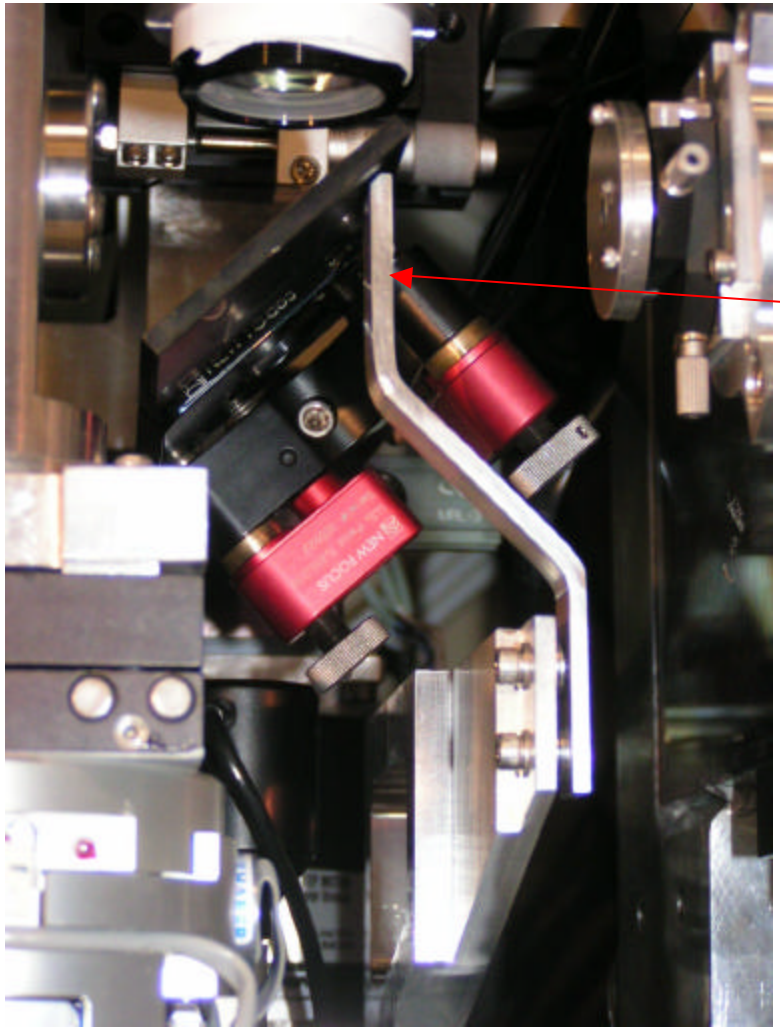
$CdWO_3$cintillator
~132.86mm from KB box.

KB pitches& translations optimized earlier with different imaging system.

Field of view is 0.920 mm and image has 512x512 pixels => 1.80 microns/pixel

17keV

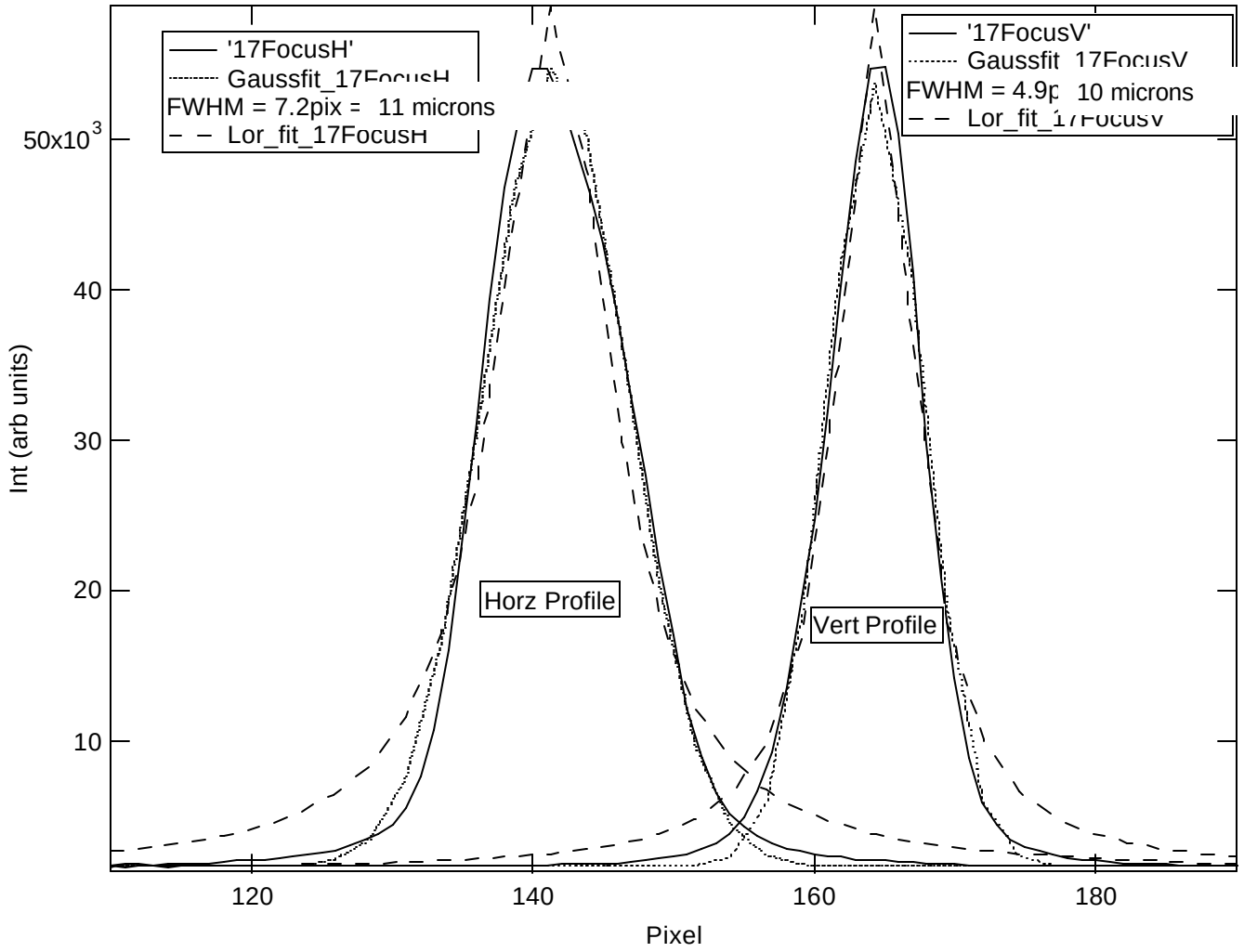
2006 Calipso Review: Experimental Stations.



100 µm pinhole mounted immediately in front of carbon mirrors removes scatter-tails from KB-mirrors.

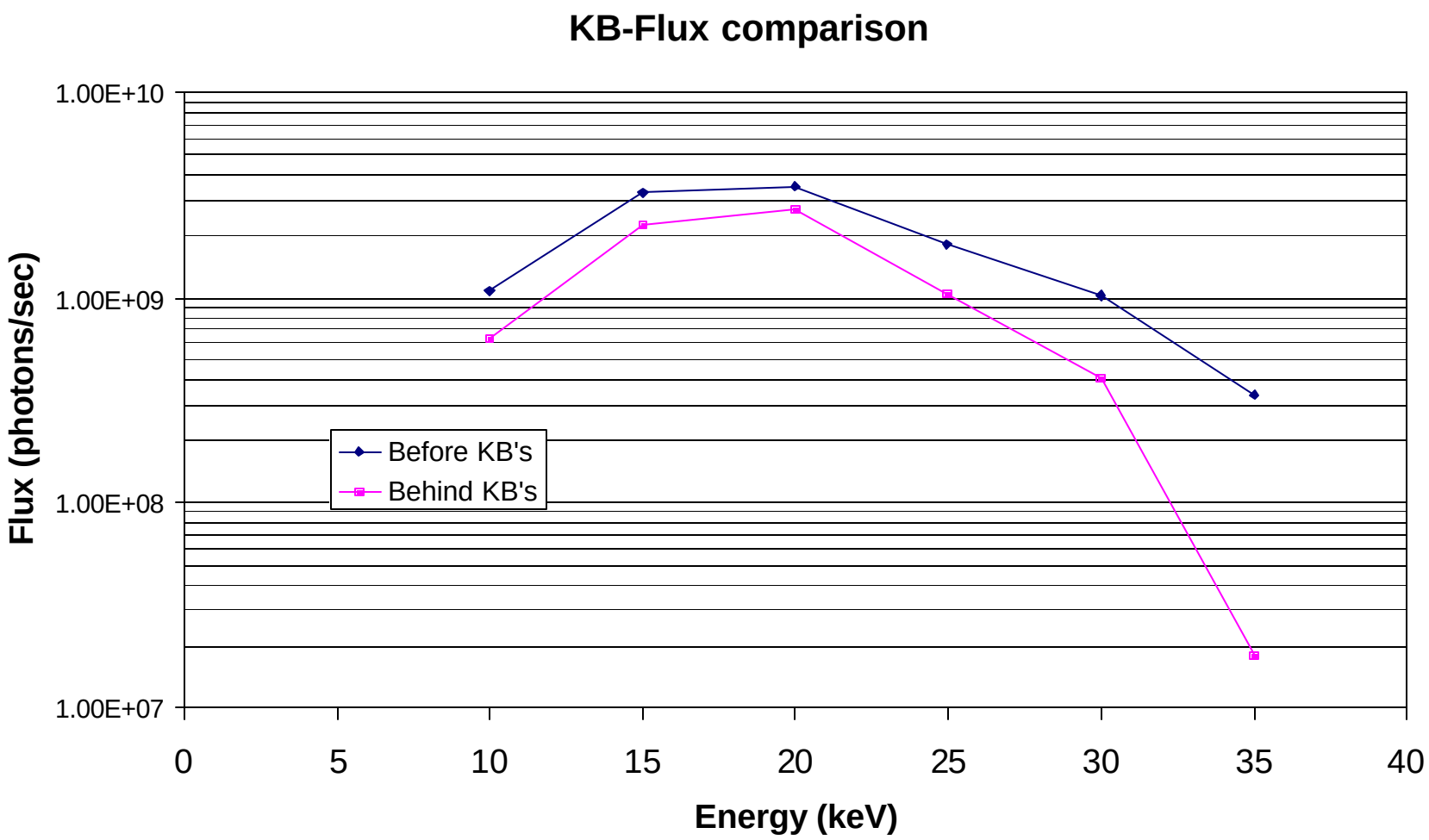
=> Virtually no gasket signal even for very small gasket-holes.

2006 Calipso Review: Experimental Stations.



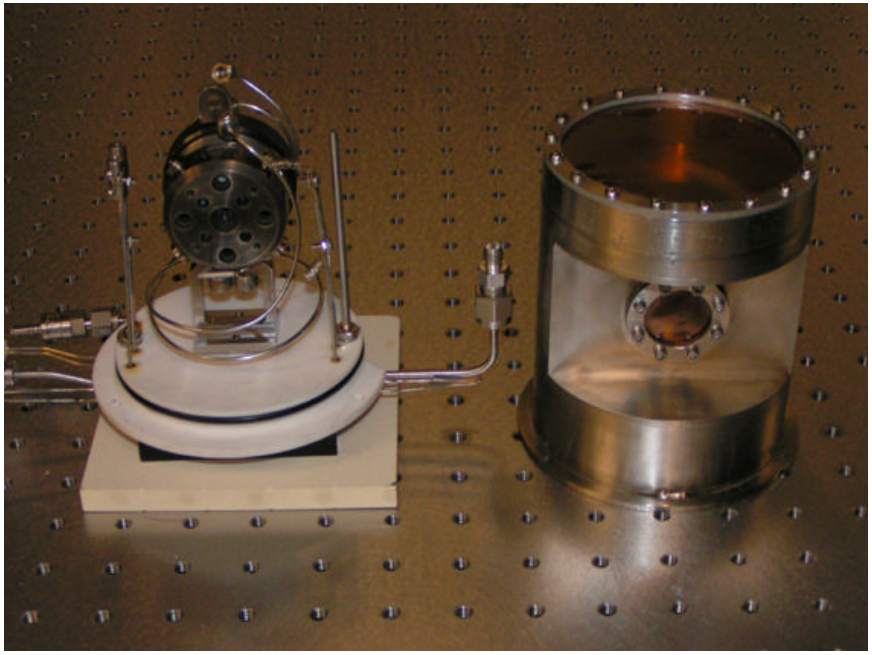
2006 Calipso Review: Experimental Stations.

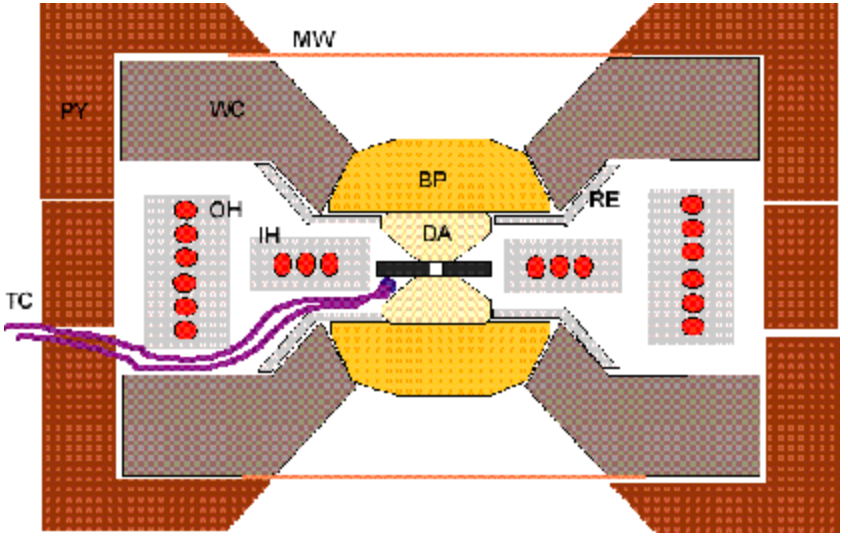
Virtual Source: 20 (h) x 60 (v) mm². Focused spot: 13 x 13 mm².



2006 Calipso Review: Diffraction experiments

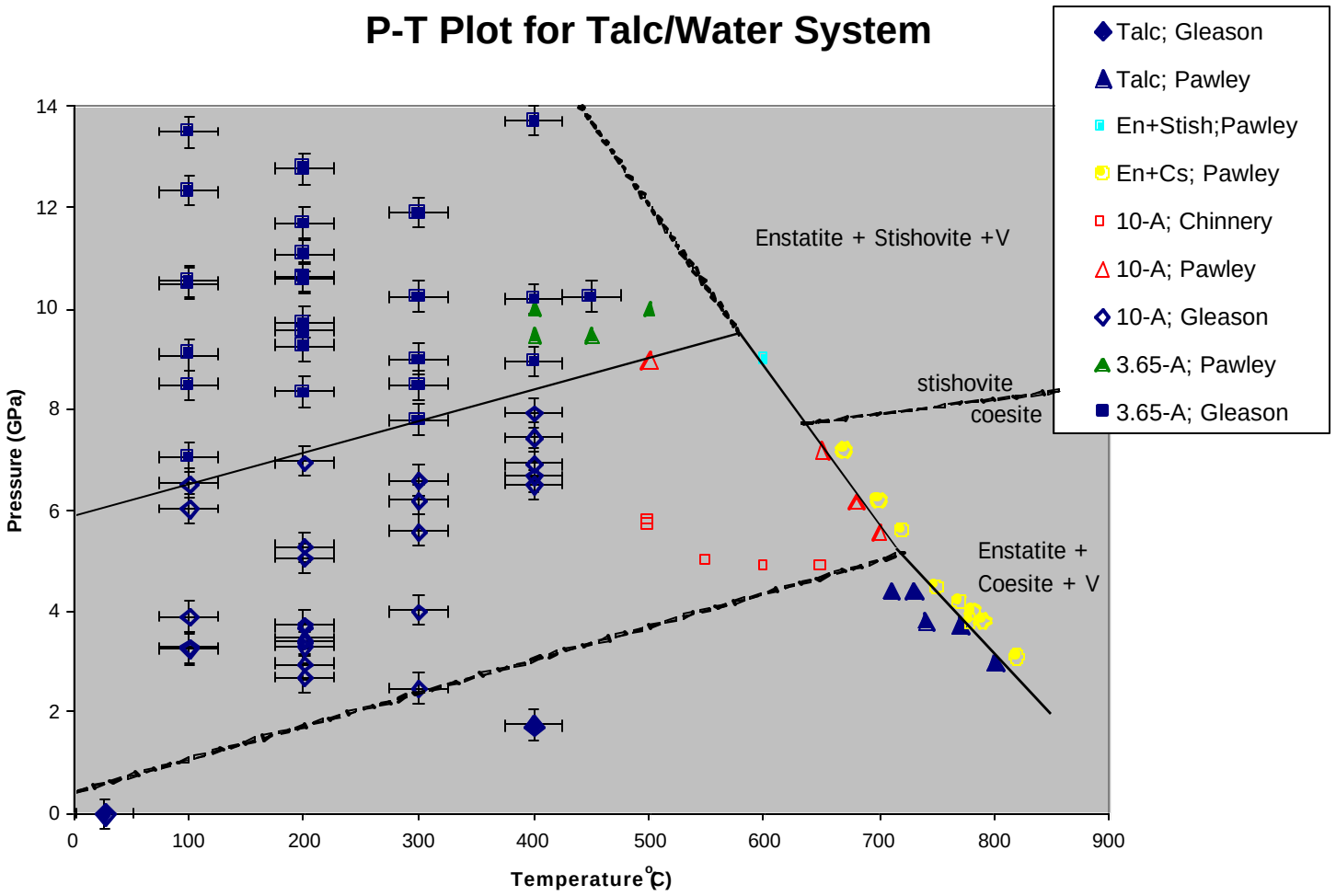
Resisitive heating:





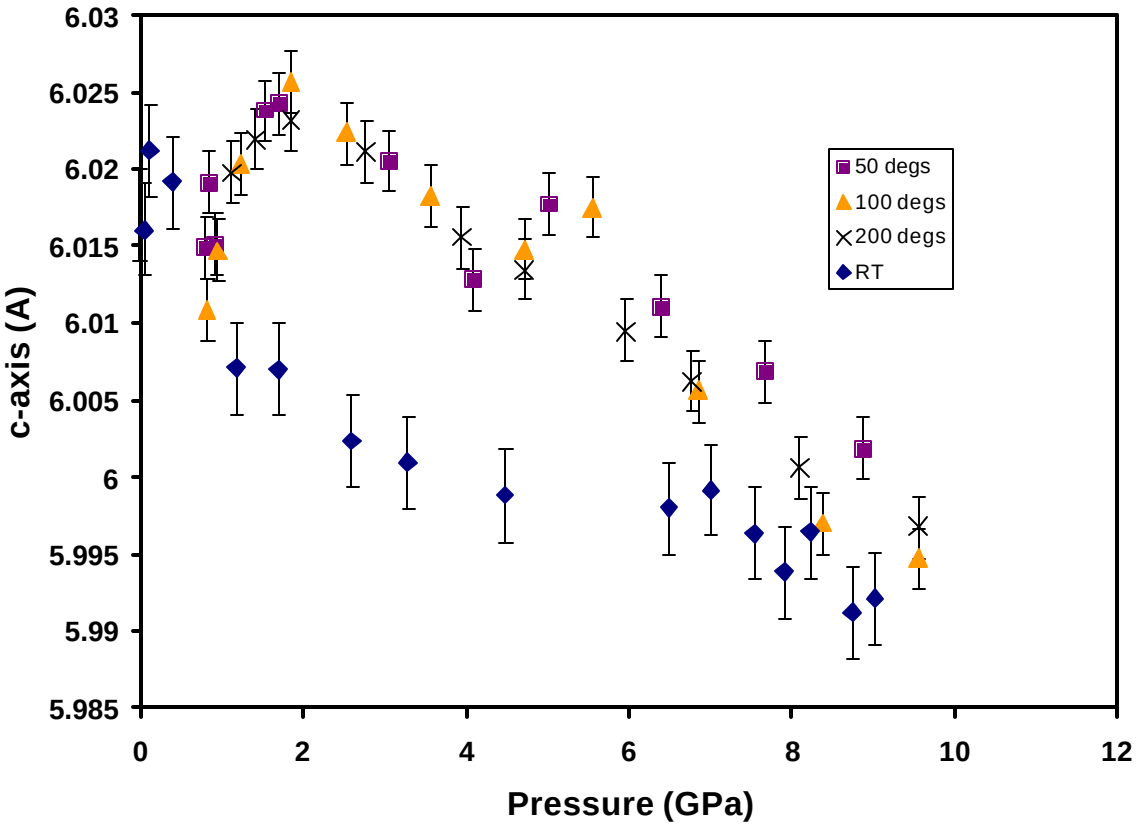
2006 Calipso Review: Diffraction experiments

Resisitive heating:

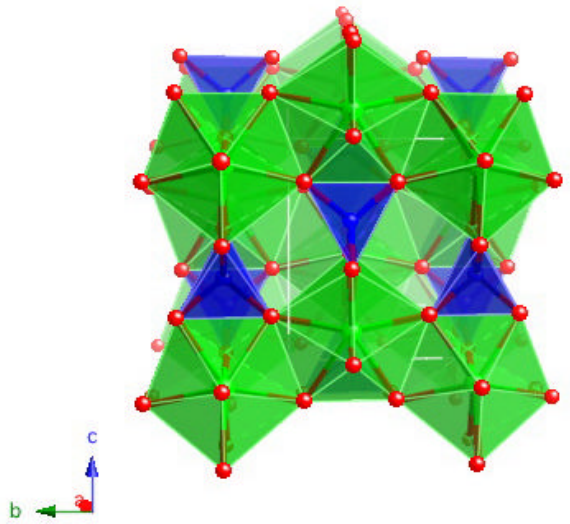


2006 Calipso Review: Diffraction experiments

Resisitive heating:



Zircon ($ZrSiO_4$):



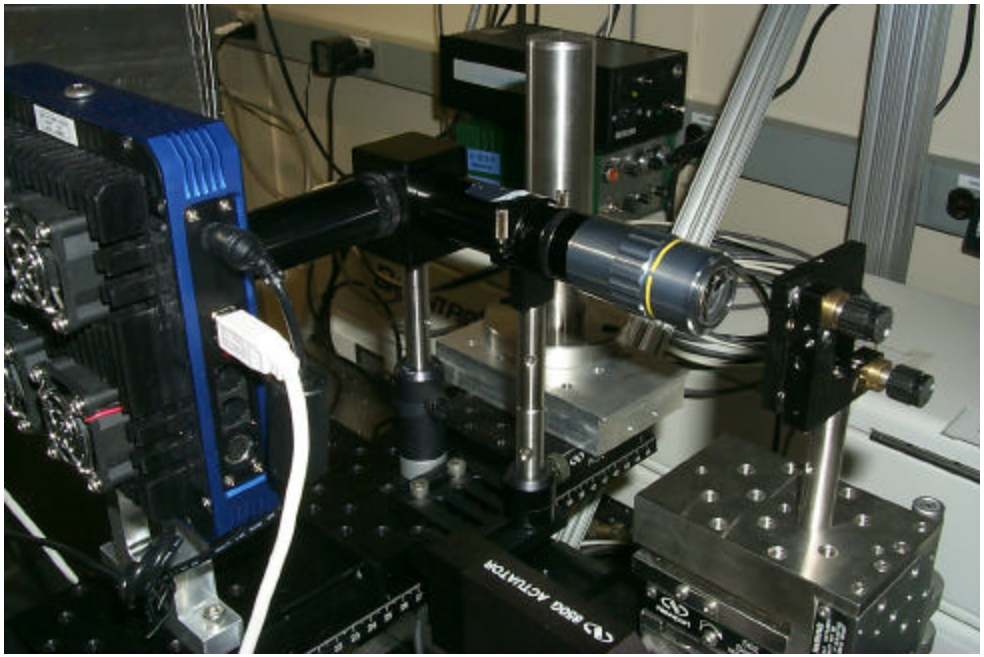
2006 Calipso Review: Imaging.

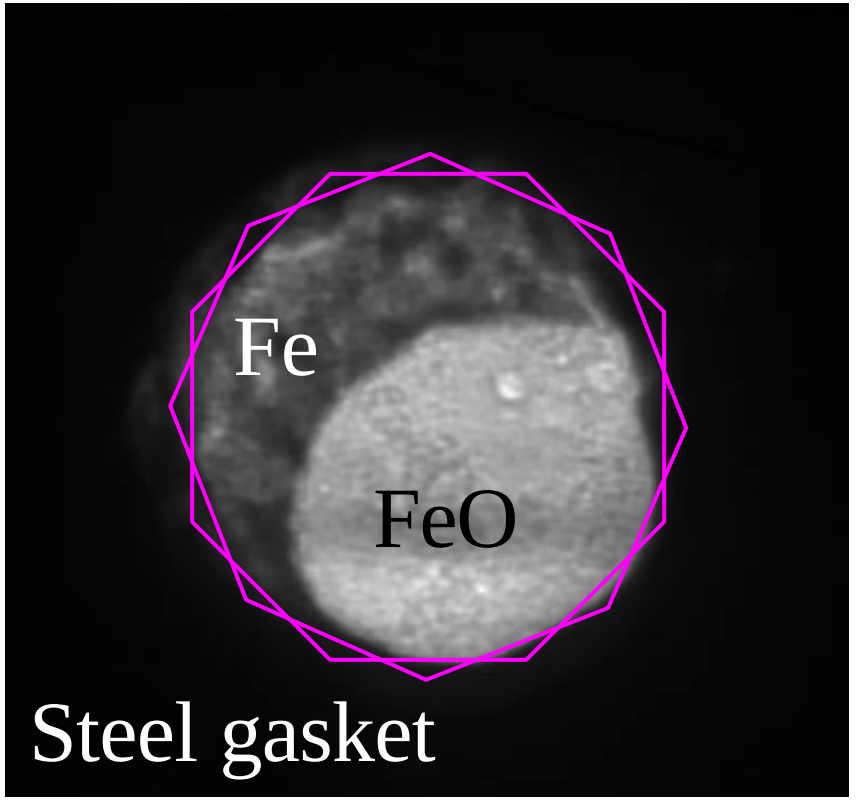
X-ray imaging as a complementary tool.

- Measuring viscosity of liquid with a rolling sphere (Jeanloz group).
- Measuring shift of eutectic / peritectic with P (Walker and Walter).

2006 Calipso Review: Imaging.

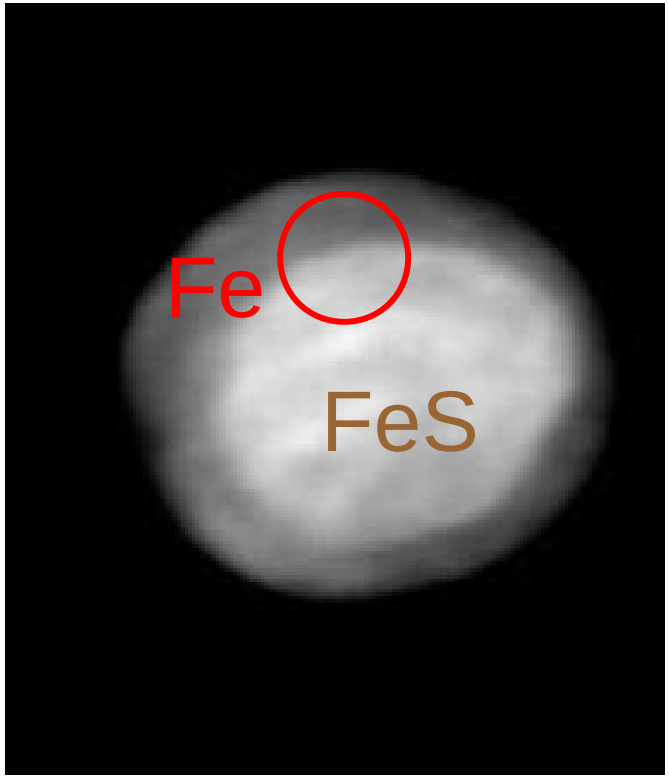
Xray-absorption imaging experiment using the Apogee camera





2006 Calipso Review: Imaging.

Observed absorption in FeS

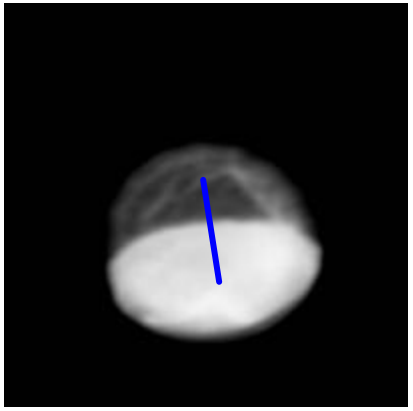


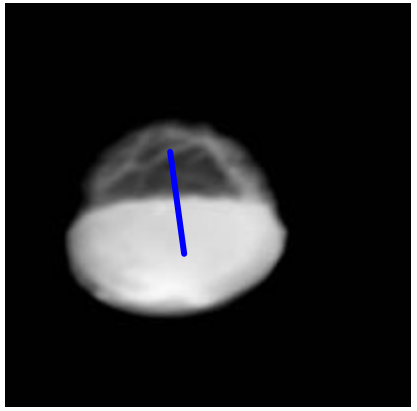
50 kbars

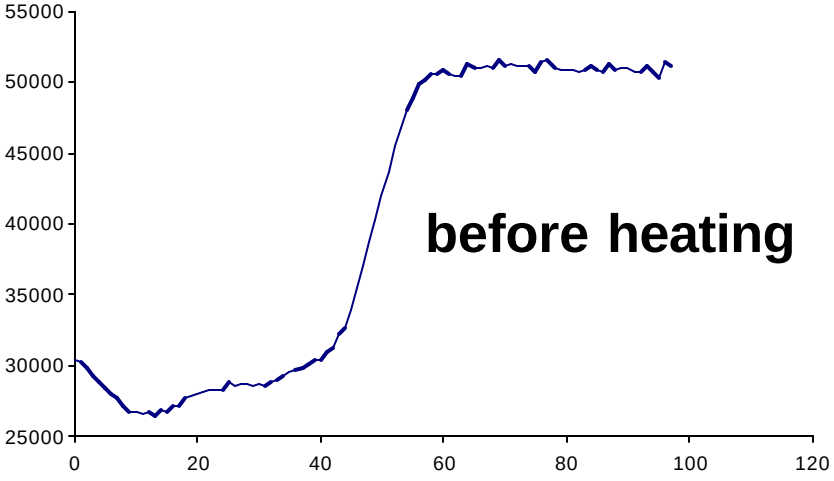
Melting shows erosion

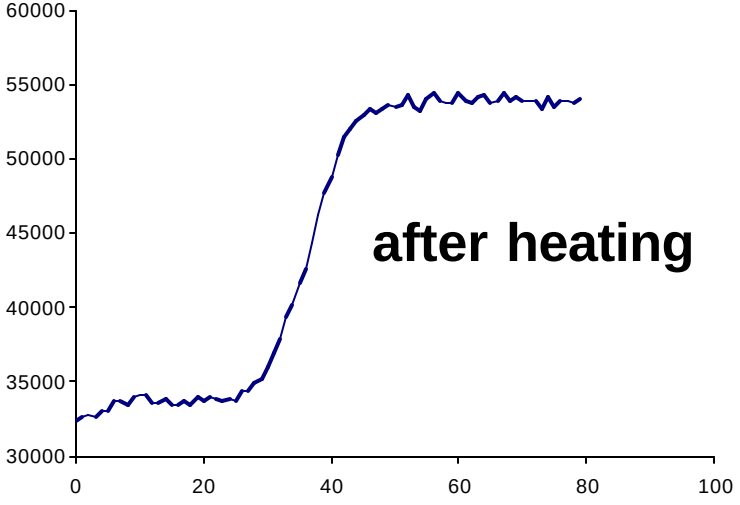
2006 Calipso Review: Imaging.

Observed absorption in FeO

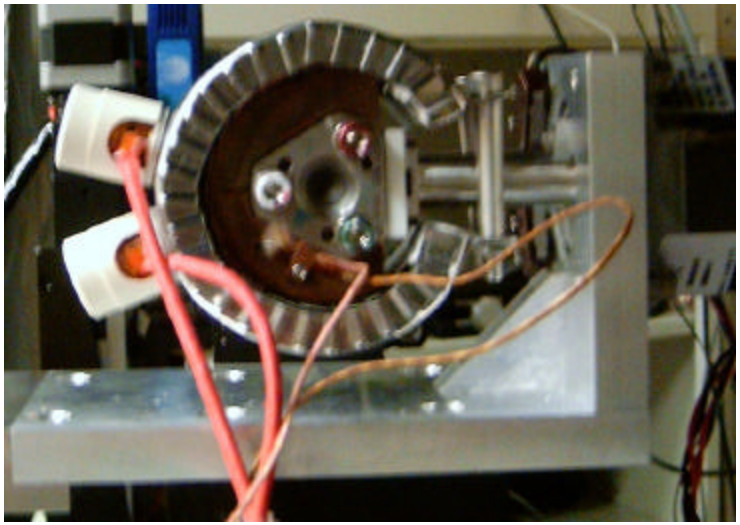


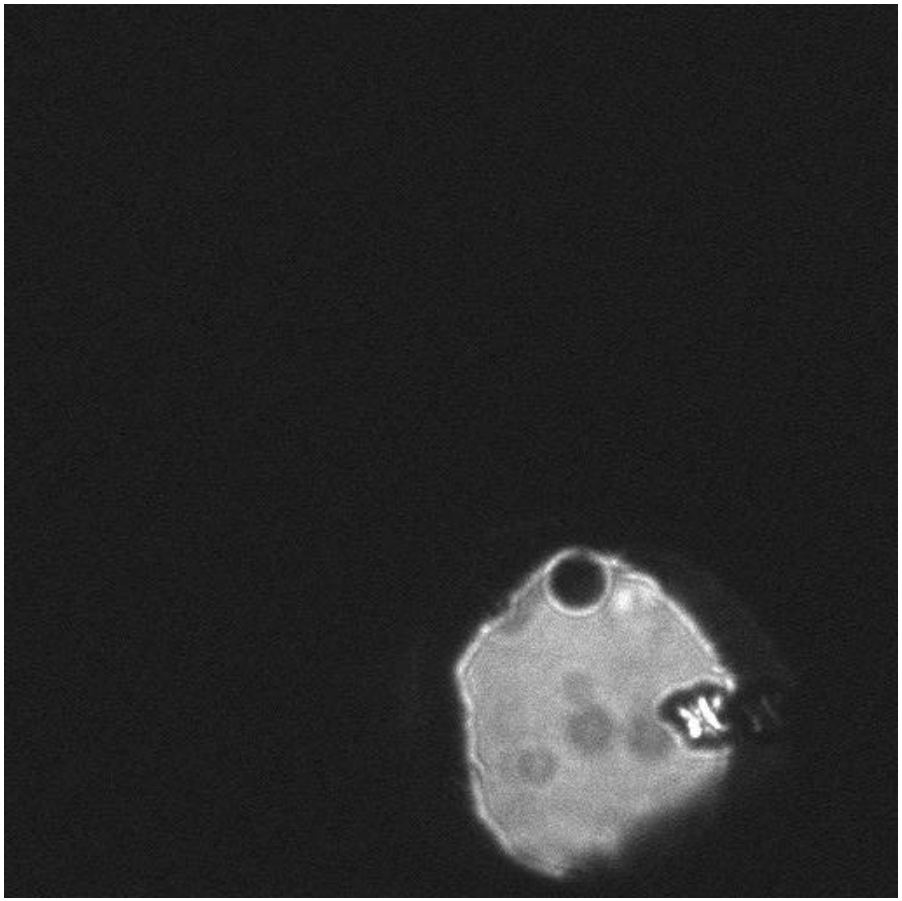




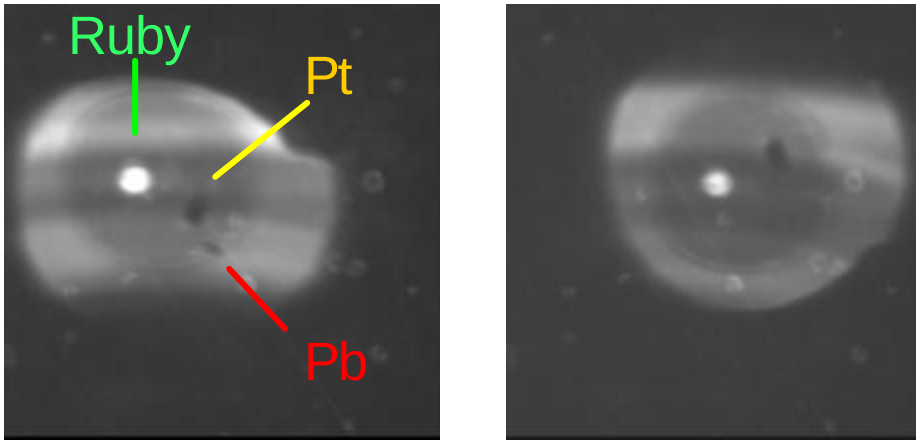


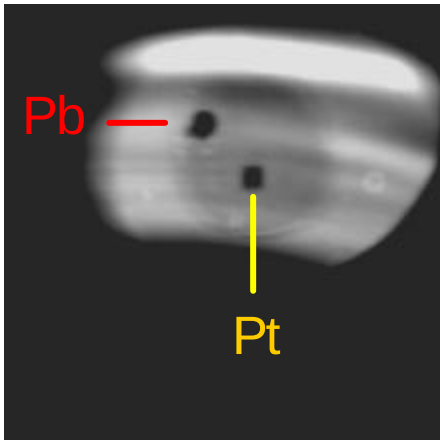
2006 Calipso Review: Rolling Sphere Imaging

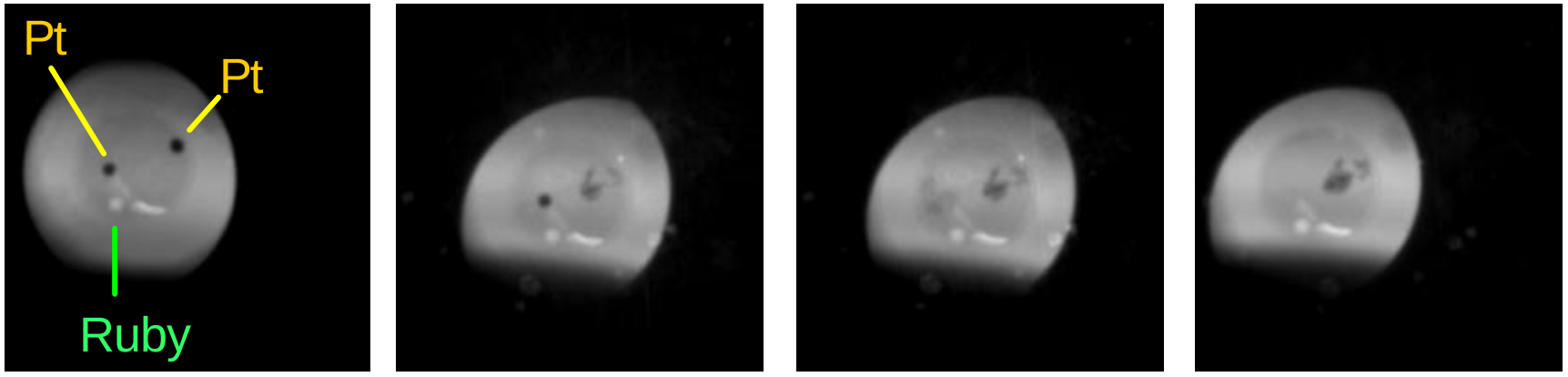




2006 Calipso Review: Imaging.

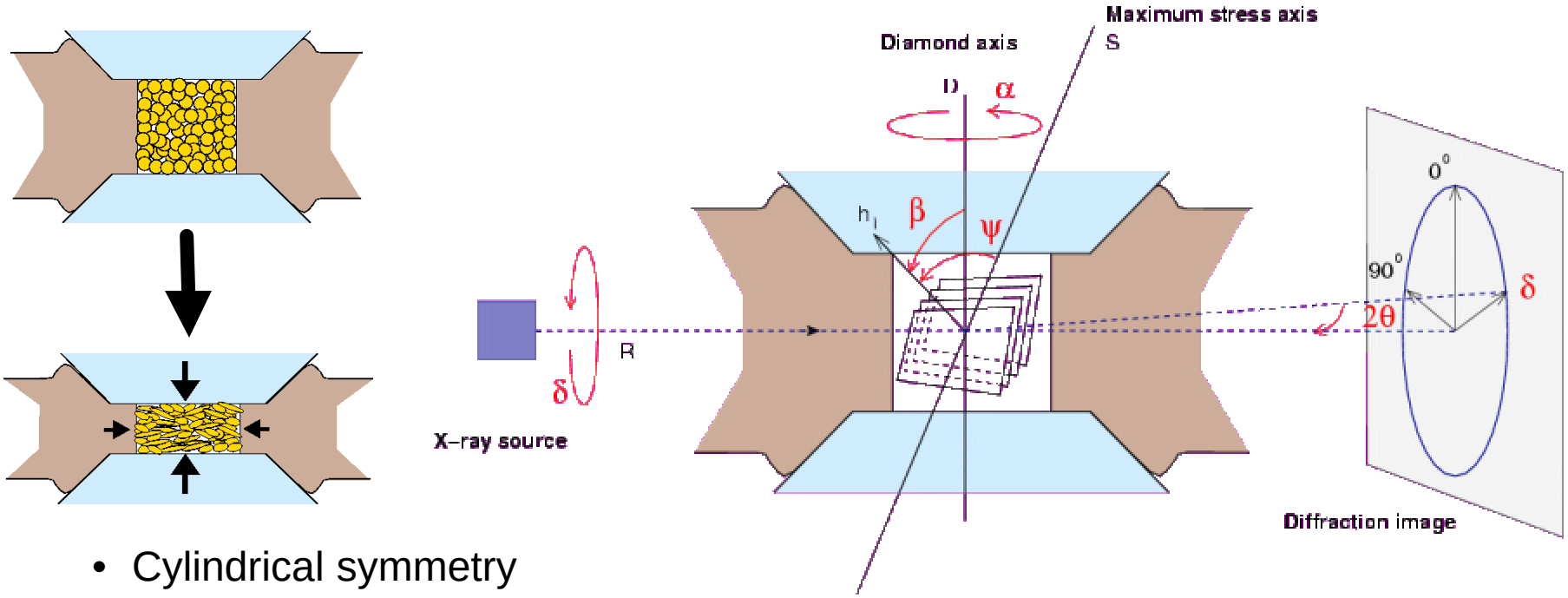






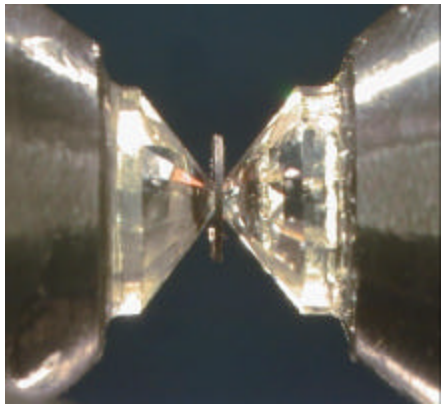
2006 Calipso Review: Radial Diffraction

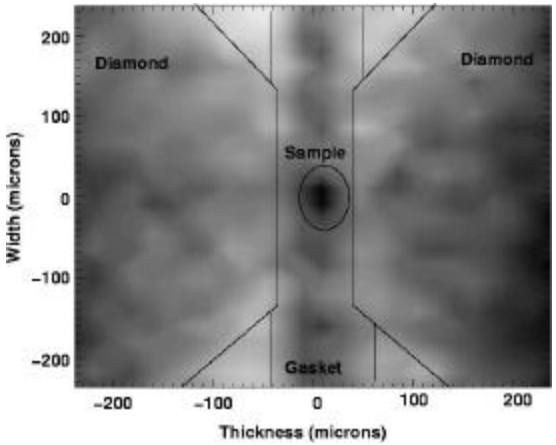
Radial x-ray diffraction geometry (Sebastien Merkel, UCB)

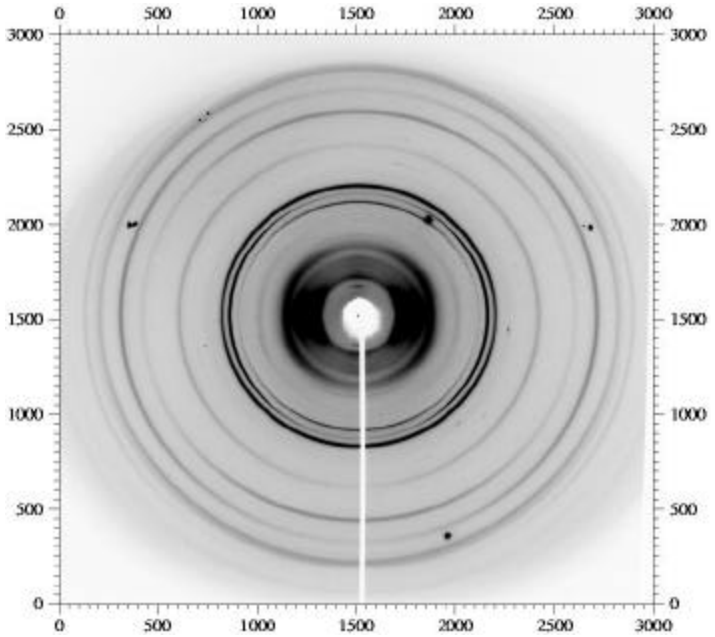


- Cylindrical symmetry
- Diffraction in radial geometry
- Diffraction patterns as a function of azimuthal angle δ
- One image for each deformation / pressure step
- Detector: image plate or CCD
- Data collection time: 30s (CCD) to 10mn (image plate)

2006 Calipso Review: Radial Diffraction

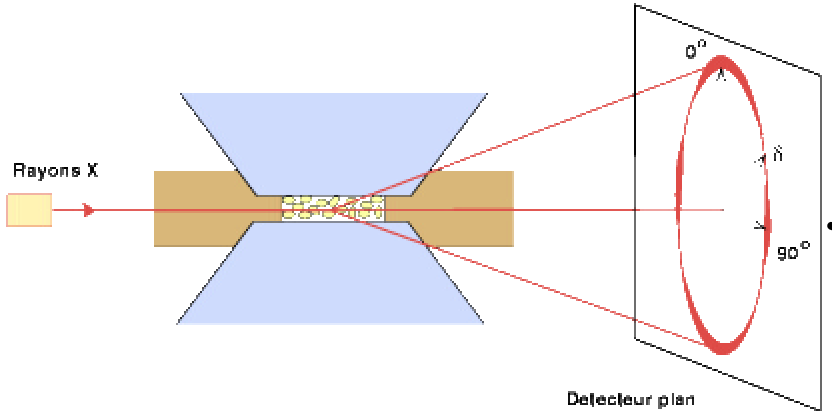






Merkel and Yagi, RSI (2005

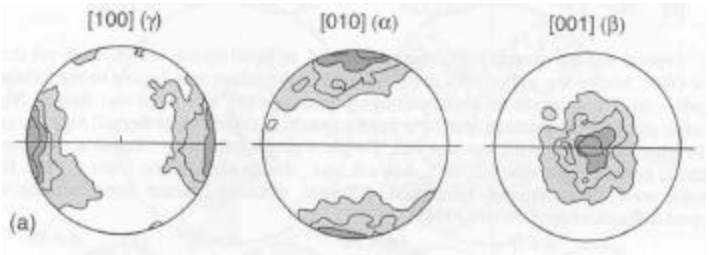
2006 Calipso Review: Radial Diffraction.



Diffraction

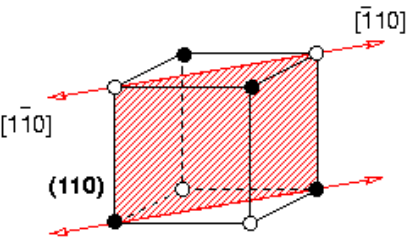
Preferred orientations

Texture analysis

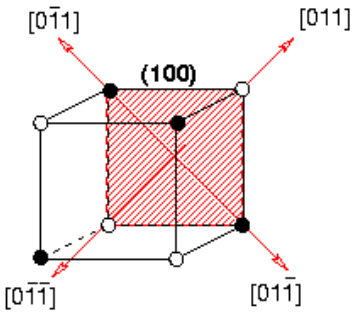


Orientation distribution function

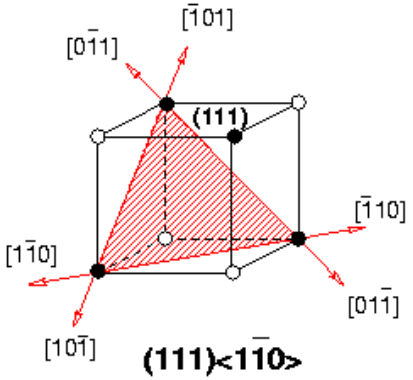
Polycrystalline plasticity models



(110)<1$\bar{1}$0>



(100)<011>

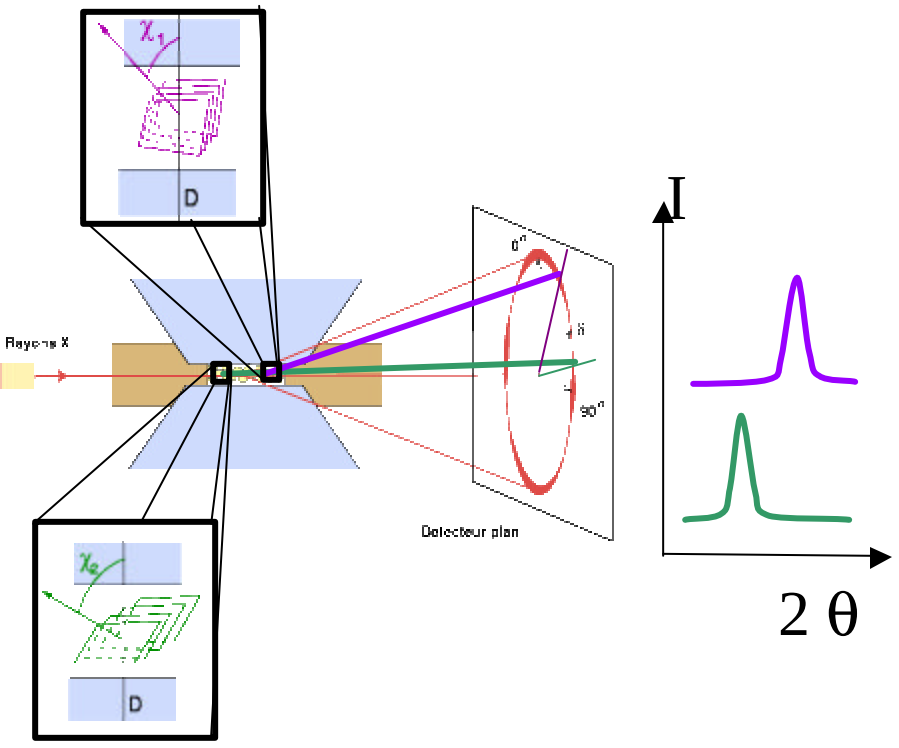


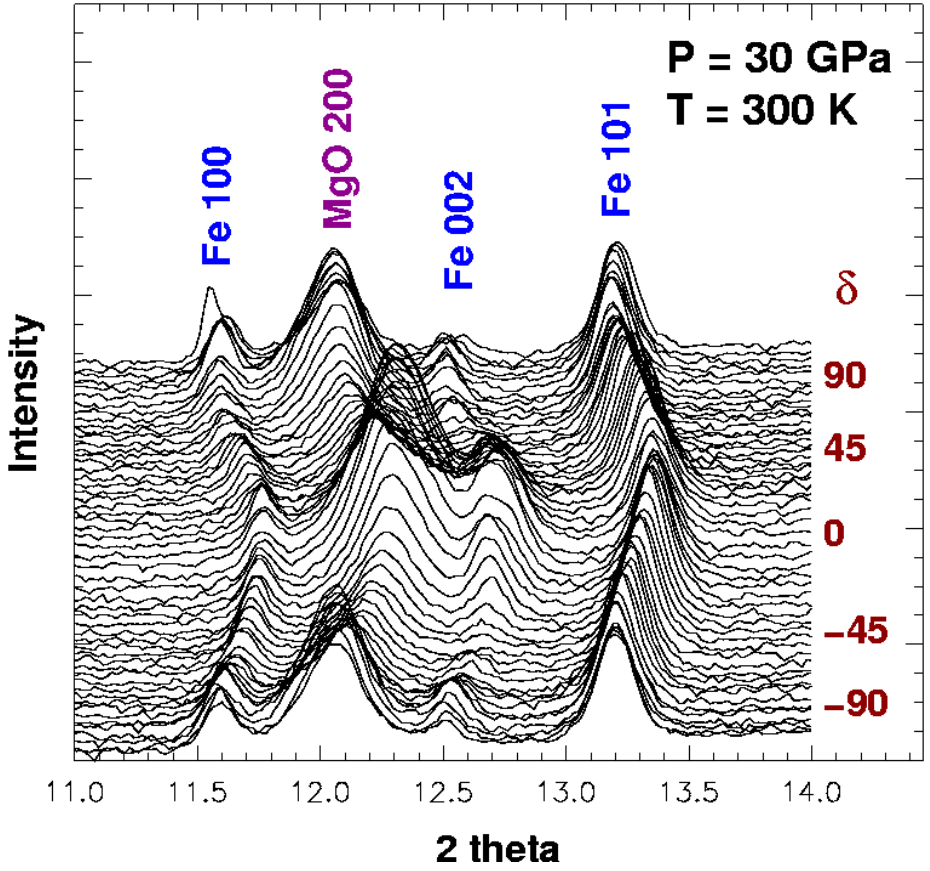
(111)<1$\bar{1}$0>

Deformation mechanisms

2006 Calipso Review: Radial Diffraction.

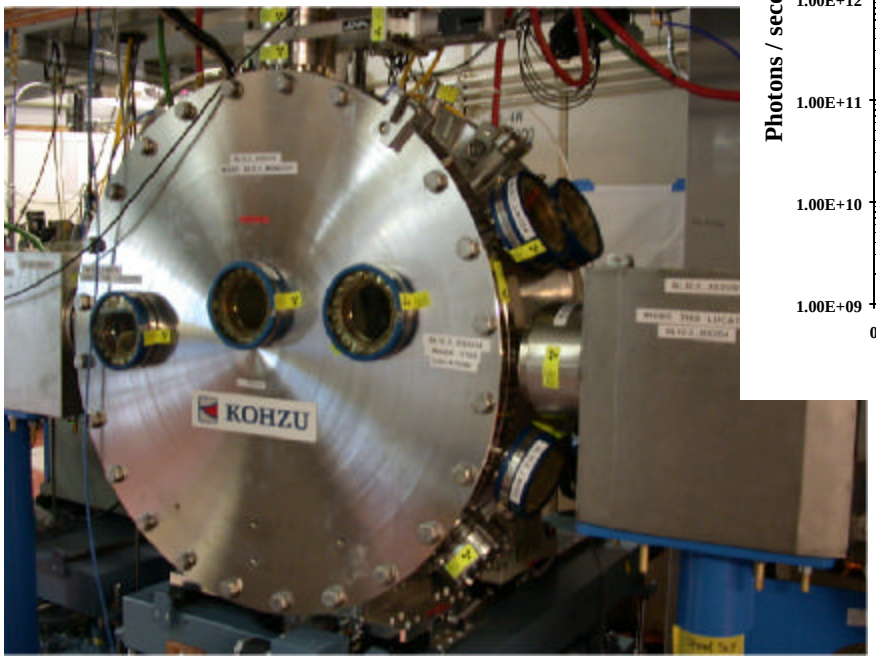
Elasticity and stress

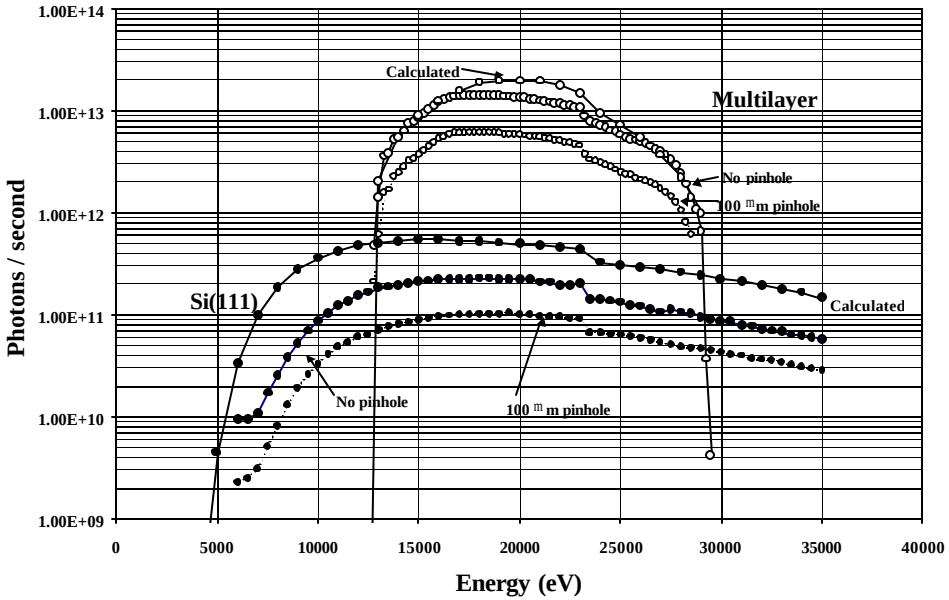




2006 Calipso Review: Developments

EXAFS

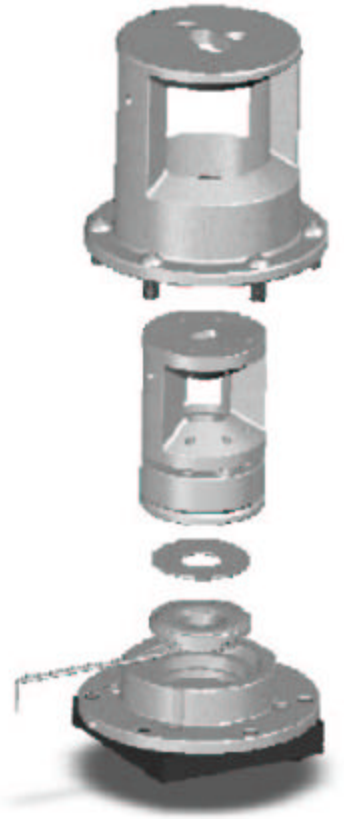




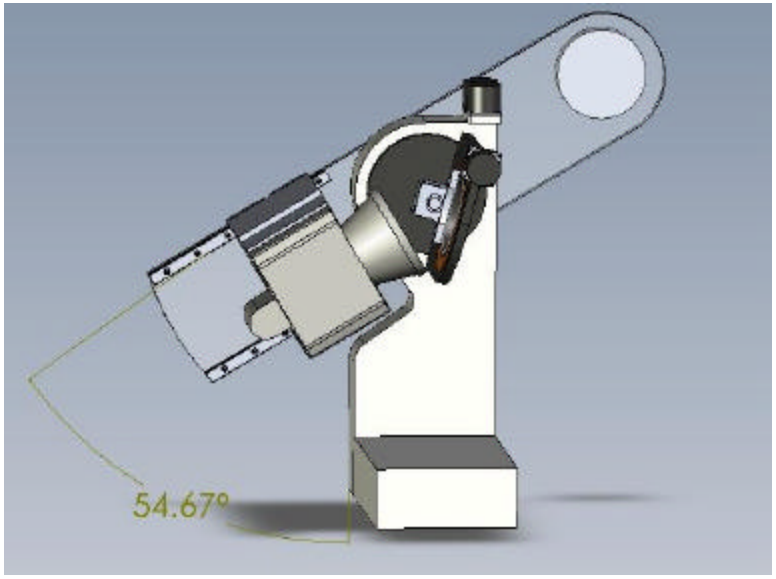
Monochromator rocking curve feedback system to be completed by end of January.

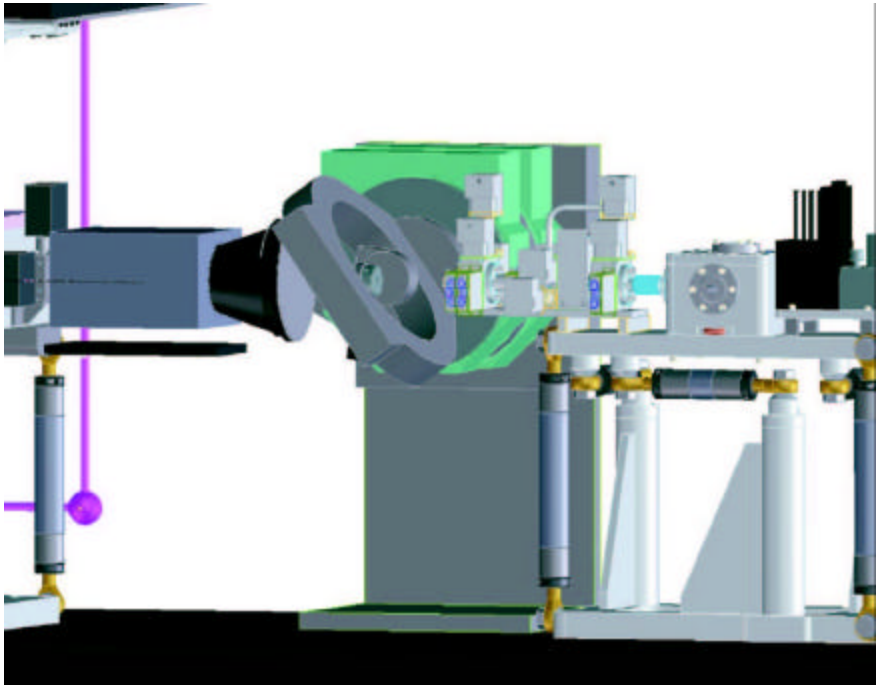
2006 Calipso Review: Developments

Remote controlled DAC for in-situ laser heating of radial diffraction.



Installation of single crystal goniometer on ES-1:





Specifications:

- 4-circle goniometer with full Eulerian cradle.
- small and sturdy design to fit in available space and allowing mounting of DAC's.
- total sphere of confusion <= 0.01 mm radius with DAC mounted.
- vertical diffraction plane to account for horizontal polarization of synchrotron beam.
- Bruker CCD detector controlled through WinView. Possibility to add / exchange with single point detector.
- omega range > +- 40°.
- 2-θ range > +- 35°.
- Controller & driver: Newport XPS.
- flexibility wrt application-software.

Further points to consider:

- Potential of technique can only be fully exploited, if gas loading (He or Ne) is available!

- Software needs to be flexible AND user-friendly. Ideally experiment can be run by user-preferred software.

- capability to expand to other ancillary equipment (heater, heatable DAC) .

- beam-size.

2006 Calipso Review: Developments

Resources needed.

- **Finances** for purchase of goniometer: available ~ 70 k$ from NSF- MRI (Nicol - Dera).
- **Mechanical** support for installation (Titus / Celestre / Morrison - ALS).
- **Electronic** support for installation (Bell - ALS).
- **Controller** software (EPICS) support (Mark Rivers, GSECars).
- **Detector** interfacing: Ed Domning / Rich Celestre - ALS, Mark Rivers - GSECars.
- **Application** software (IDL based) support (Przemek Dera, GSECars. R. Angel VPI (?)).
- **Beamline** support (Kunz - COMPRES / ALS).

2006 Calipso Review: Developments

Spring shut down

Nov. 06

May 07